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## NOTES ON ABDOMINAL WOUNDS RECEIVED IN BATTLE

FRED W. RANKIN, M.D.

and

LAWRENCE E. HURT, M.D.

Lexington, Kentucky

**W**OUNDED soldiers of the American Army in World War II received surgical care superior to that ever given to battle casualties in any war at any time. This was due to a number of factors. The main one was a large pool of properly trained young surgeons who came out of the residency system which is now a part of our postgraduate training program.

A second factor was the determination of the Army to practice surgery by specialty in a manner parallel to that practiced in civilian life.

A third factor was the organization of transportation facilities which permitted adequate recovery and removal of the wounded.

A fourth factor was the placing of surgeons well forward in the combat zone, thus bringing the surgeon to the patient rather than transporting the patient to the surgeon.

In the main non-transportable cases which consisted of abdominal wounds, sucking wounds of the chest, and severe lacerated wounds of the thigh were operated on by surgical teams from auxiliary groups which were distributed to field hospitals and sometimes to clearing companies within the Divisional area. Transportable cases were operated on largely in evacuation hospitals which were located five to ten miles back of the line of advance. Early surgery was done by skilled surgeons and the results were reflected in an enormous lowering of mortality and morbidity rates.

Another factor which reduced the mortality and aided in the

over all picture was the employment of whole blood and plasma to combat circulatory failure in seriously wounded soldiers. In the Italian theater whole blood was procured in the Army area from Service troops. In the E.T.O. and the Pacific area whole blood was shipped by the Office of the Surgeon General from the United States to the battlefields.

Both programs were highly successful and were functioning smoothly throughout the combat time. The early enthusiasm for plasma and the wonderful record made by the American people through the Red Cross in procuring plasma undoubtedly developed a most useful adjuvant to surgery, but it must be remembered that plasma is not a substitute for whole blood but is a supplement to it in the treatment of shock.

The treatment of infection by the utilization of early and adequate wound debridement plus the administration of chemotherapeutic agents was also an important factor in the successful management of battle wounds. The tendency to credit too much of the success in handling battle wounds to chemotherapeutic agents is a deplorable one and it may be said with some justification that in certain instances the widespread utilization of sulfa drugs without adequate surgery left much to be desired in the management of these wounds.

Lyons<sup>4</sup> of New Orleans has recently published a most interesting article, in which he says, "It is important to emphasize the *limited* role of chemotherapy in the management of wounds. The basic tenet of the current philosophy in this regard is sound surgical care. Blood transfusions and chemotherapy are important features of a supportive program designed to expedite the surgical treatment of the wounded. Of all the measures devised to prevent infection, only active immunization with tetanus toxoid may be said to have achieved its purpose *completely*. The only other prophylactic procedure of comparable value is initial surgical management of the wound. The greatest usefulness of antibacterial drugs has been in the therapy of impending or established infection complicating the surgical management of the wound."

One would not detract from any agent available to reduce infection or forward surgical care of wounded men, but calm and dispassionate evaluation is necessary in accepting the responsibility for policies to handle battle casualties. The over all reduction in mortality in World War II from World War I is customarily admitted to be great. In World War I, the over all mortality is usually figured as 8.4 and World War II as 3.7. These figures reflect progress

but it should be emphasized that mortality figures in different fields varied enormously. The over all figure in abdominal wounds which were seriously complicated wounds is still somewhere between 30 and 40 per cent, depending on many factors: 1. Type of wounds; 2. Time interval between wounding and surgical intervention; 3. Experience of the operating surgeon; 4. Availability of whole blood, therapeutic agents, etc. General considerations in the care of abdominal injuries which are presented below are drawn largely from a report of the 2nd Surgical Auxiliary Group, which operated in Italy, to the Surgeon General's Office in 1945. Of this group, one of us (L.E.H.) was the head of a surgical team operating in forward areas and handling a large number of abdominal casualties. This report contains data on 327 cases of abdominal wounds operated on by 26 different surgical teams and with an over all mortality of 37.5 per cent.

The problems most frequently encountered during the initial surgery of abdominal wounds are: 1. Traumatic shock of varying degree complicated by hemorrhage; 2. An evaluation of anatomic damage; 3. Tissue defects contaminated by extraneous bacteria and gross foreign material, and, 4. Fecal contamination of the peritoneal cavity in those sustaining perforation of the intestinal tract.

The term abdominal wound usually implies intestinal perforation but not necessarily so since injuries of the abdominal wall, retroperitoneal structures, and the solid viscera are included. In some instances, the pathway of a missile may involve only the abdominal wall while in others the wound tract may include all of the above anatomic areas. The treatment of abdominal wounds obviously is largely concerned with whether or not there is penetration of the peritoneal cavity and laceration of the viscera.

*Diagnosis.* Inspection of the wound, particularly the perforating type, frequently provides a fairly clear mental picture of structures involved in its pathway. The penetrating type of wound requires roentgenologic examination in both the postero-anterior and lateral directions with approximate anatomic location of the missile before an accurate estimation of structural damage can be determined. Auscultation of the abdomen may reveal an absence of peristaltic waves, one of the earliest signs of intestinal perforation. Signs of peritoneal irritation appearing early and accompanied by severe pain and signs of hemorrhagic shock are indicative of enormous blood loss into the peritoneal cavity as might be expected from injury to the liver, spleen or mesenteric vessels. The two most important points not to be overlooked in the physical examination are: 1. The rectal examination, to see whether there may be fresh blood

indicative of rectal wounding, and 2. A testing of the motor and sensory functions of the lower extremities for possible injury to the spinal cord or major nerve trunks. The necessity of complete emptying of the bladder by catheter cannot be overemphasized because in some wounds of the bladder 24 hours old or older, a large amount of exudate has formed about the perforation with cessation of bleeding. Consequently, only the last few cubic centimeters of bladder urine will contain blood. Too, an empty bladder greatly facilitates exploration of the lower abdomen and pelvis. If the catheterized urine contains gross blood, the catheter should be anchored so that the bladder may remain empty during the operation.

Nasogastric intubation with suction before operation serves two useful purposes. First, gross blood in the gastric contents is indicative of stomach injury, and secondly, an empty stomach eliminates any risk during inhalation anesthesia of aspirating vomitus into the tracheobronchial tree. In the absence of gross blood in the gastric contents and should the Levine tube prove ineffectual in emptying the stomach, then a bulb-type tube may be passed and moderate gastric lavage instituted. In spite of all our diagnostic aids, an occasional patient with intraperitoneal penetration may present no signs of such injury; particularly is this true when the wound of entry is located in the buttocks, thigh, perineum, or lower thorax. Such cases should have exploratory laparotomy since exploration is surely less harmful than an overlooked intestinal perforation.

*Shock—Resuscitation Therapy—Preoperative Care.* Preoperative preparation of patients sustaining intra-abdominal wounds consists chiefly of combating peripheral circulatory failure and hypoxia. Whole blood in adequate quantity is the most suitable agent for elevating a lowered circulatory volume, a decreased hemoglobin, and restoring systolic blood pressure to normal. Many patients on admission to the hospital present no clinical signs of hemorrhagic and traumatic shock. However, in our experience they develop varying degrees of peripheral circulatory failure during surgery whenever preoperative resuscitation is omitted;<sup>1</sup> a few patients are admitted in severe shock whose response to vigorous replacement therapy—2000 c.c. to 4000 c.c. of blood within three hours—is slow or nil. It is fair to assume, according to Berry,<sup>2</sup> that this group is suffering from (1) continuing hemorrhage; (2) massive peritoneal contamination with peritonitis or, in wounds of the buttocks and rectum, pelvic cellulitis, anaerobic myositis or cellulitis; (3) a large evisceration; (4) blast injury of the lungs, heart, abdomen, or brain; and (5) other severe wounds.



Plasma alone is not sufficient but is the best substitute for blood to maintain blood pressure and should be used only until blood is available. Oxygen, preferably administered by mask, is indicated during the period of resuscitation on account of the secondary anemia with reduced oxygen-carrying power of the red cells or because of associated chest injury. It is considered safe to proceed with the operation if the peripheral circulation has returned, the systolic blood pressure is 85 or above, and the skin is warm and dry.

*Operations.* Incision and debridement of the wound tract: A long paramedian incision is preferred since it not only gives good exposure but allows for complete examination of the gastrointestinal tract. It should be placed, if possible, so that the wound tract is not crossed because this area will almost invariably become involved by subsequent infection. Another advantage of paramedian incision is that adequate surface laterally provides space for separate drainage and colostomy incision.

Thorough debridement of the wound tract is most important in both the penetrating and perforating types of wounds. This procedure is usually reserved until last unless there is a question of intraperitoneal penetration, then it may be done first. This method of operative approach will spare exploratory laparotomy in those with only abdominal wall injury.

*Liver.* Fortunately, most wounds of the liver have ceased bleeding at the time of operation. The wound tract should be inspected, with removal of bits of clothing, spicules of bone, and other foreign substances conducive to abscess formation. All wounds of the liver should be packed loosely to prevent bleeding after operation when the circulation improves.

The Penrose gauze drain with the gauze extending several inches beyond the drain is ideal for this procedure. The gauze, if packed loosely, does not interfere with drainage of serum and bile from the wound tract, yet provides a supporting surface for clot formation in the event of postoperative hemorrhage. Adequate external drainage is most important in the initial surgical management of liver injuries. Serum, bile, and foreign material overlooked at operation tend to collect in the hepatic spaces, particularly the sub-diaphragmatic space. Such accumulations often lead to abscess formation. In those patients sustaining concomitant diaphragmatic injury, serum, and bile accumulations tend to drain through the diaphragmatic repair resulting in bile empyema and persistent sinuses. After meticulous placement of the drains, the opposite ends are brought out preferably through a wide subcostal incision lateral

to the paramedian incision. A staged removal of the drains is started on or about the fourth postoperative day. Complete removal of the drains is accomplished on the tenth postoperative day, dependent on the type and amount of drainage.

*Kidney.* Wounds of the poles of the kidney respond well to packing and drainage. Injuries to the renal vessels or fragmentation of the organ necessitate nephrectomy followed by flank drainage.

*Spleen.* Repair of injury to the spleen by means of suture or muscle grafts are considered worthless and time-consuming procedures. Neither procedure can be relied upon to control active hemorrhage, prevent subsequent hemorrhage, or repair the damage to the organ. Consequently, splenectomy is the operation of choice for all splenic injuries.

*Small Intestine.* The small intestine itself, its mesentery, or both, because of their large surface areas, are frequently injured in wounds of the abdomen. Multiple perforations not too widely spaced are the rule. Before attempting repair, thorough but gentle exploration of the small intestine and its mesentery from the pylorus to the ileocecal junction is essential. Injuries to the second part of the duodenum are easily overlooked unless this structure is adequately exposed by mobilization of the hepatic flexure. The method of operative repair should be one that is expedient and conservative, resulting in preservation of bowel lumen and security from leakage. Two closely associated perforations may be converted into one and the ensuing defect closed with one layer of intestinal catgut and one layer of fine interrupted silk sutures. Multiple perforations confined to a small area, especially involving the mesenteric surface of the small intestine, may require resection with an end-to-end type anastomosis. Mutilated small bowel always requires resection and anastomosis.

*Colon and Extraperitoneal Rectum.* Surgeons engaged in the initial management of intra-abdominal injuries, particularly colon injuries, are cognizant of the fact that many patients fail to survive. Ogilvie<sup>3</sup> reported 107 injuries of the colon with 63 deaths. For obvious reasons, it is emphasized that primary suture of the unprepared colon in the presence of peritoneal contamination should not be performed. Consequently, all initial operations are designed to divert the fecal current outside the peritoneum. The only exception to this rule are those patients sustaining injury between the sigmoid and extraperitoneal rectum. These perforations are closed by suture and supplemented by proximal colostomy. The type and severity of the injury occurring between the terminal ileum and sigmoid

colon usually determines whether a loop or double-barrel colostomy with spur is to be performed. Single or closely associated multiple anterior and lateral wall perforations and antimesenteric hemisections are exteriorized as loop colostomies. Mesenteric hemisections, transections, and extensive injuries necessitating resection of the colon are exteriorized as double-barrel with spur colostomies. The endeavor is to perform an initial operation which not only diverts the fecal current extraperitoneally, but also leaves the patient with a simple stoma which can be closed secondarily without entering the peritoneal cavity. Since the extraperitoneal closure of a loop colostomy of the right colon is impractical, a single perforation of the right colon is treated by tube colostomy or cecostomy. The tube and about two centimeters of adjacent tissue around it are extraperitonealized through a stab incision to prevent any subsequent leakage into the peritoneal cavity. At the secondary operation, this extraperitonealized portion of colon is utilized to close the colonic fistula without entering the peritoneal cavity.

Injury of the hepatic flexure is likely to be complicated by injury to the second part of the duodenum. Whenever the hepatic flexure is injured it should be mobilized exposing the second part of the duodenum for thorough inspection.

Injuries of the splenic flexure and the left half of the transverse colon complicated by those of the left diaphragm and left lung caused by a single missile may be operated upon transdiaphragmatically. Some of the advantages of a transthoracic operative approach to abdominothoracic wounds are: Excellent visualization of the wound tract; easy removal of the frequently fragmented spleen; mobilization of the splenic flexure under direct vision; and the elimination of the separate celiotomy incision, with its subsequent pain and the postoperative institution of an intensive cough routine so necessary for the postoperative intrapleural injury. Before closure of the diaphragm, the injured segment of the splenic flexure or transverse colon is exteriorized either as a loop or double-barrel colostomy with a spur through a stab incision in the left upper quadrant of the abdomen. Likewise, if drainage of the abdomen is desired, the drains are brought out through another, but smaller, stab incision of the left abdominal wall.

The initial surgery of extraperitoneal perforations of the rectum consist of thorough debridement of the wound tract, suturing of perforations, and sigmoid colostomy. In addition, a curved incision inferior to the coccyx with incision of the fascia propria are done to insure adequate drainage of the retroperitoneal, posterior, and

perirectal spaces. A loop colostomy of the sigmoid is not satisfactory because fecal material continually spills into the distal loop. Instead, the sigmoid is transected and a double-barrel colostomy with spur is made.

*Chemotherapy-Postoperative Care.* Methods of administration and dosage of sulfonamides are those developed and advocated by theater and Army Consultants for the guidance of Forward Area surgeons. An amount not exceeding 10 Gm. of sulfonamide per patient was used at the initial operation. Five grams were dusted into the peritoneal cavity before closure of the abdominal wall. The remaining 5 Gm. were dusted into, and distributed proportionately, among the operative sites of abdominal wounds. Consequently, those patients sustaining only an intra-abdominal injury received 5 Gm. of sulfanilamide at operation. Intravenous sodium sulfadiazine was started 24 hours after operation in the dosage of 2.5 Gm. every 12 hours until the patient could tolerate 1 Gm. orally every 4 hours. The only exceptions to this rule were in patients whose urinary output did not exceed 1200 c.c. daily, in spite of an adequate fluid intake.

Penicillin was administered routinely in the dosage of 50,000 units intramuscularly every 3 hours for the first 2 days, then 20,000 units intramuscularly every 3 hours for 3 to 5 days or longer, if indicated.

Streptomycin was not used in the management of colon injuries because it was not available. This chemotherapeutic agent has possibilities of further reducing the mortality of colon injuries and may even alter some concepts of present day operative management. For instance, it is possible that small wounds of the colon with minimal peritoneal contamination may be safely sutured instead of either exteriorization or suture and proximal decompression.

In addition to chemotherapy, postoperative care consists of skilled nursing, correction of protein and vitamin depletion and the utilization of blood to combat shock. A lowered blood protein due to loss from hemorrhage and inadequate protein intake was compensated by the administration of plasma. Hydration and nutrition were maintained by the daily administration of 3000 c.c. or more of 5 per cent glucose in normal saline. Ileus and abdominal distention were controlled by nasogastric suction. The more obstinate cases required small bowel intubation. In the absence of marked peritoneal infection, delayed colostomy function was initiated by the instillation of 30 c.c. of mineral oil into the proximal loop of the colostomy on the fourth or fifth postoperative day.

## SUMMARY

Problems encountered in the initial surgical management of abdominal wounds are presented. Preoperative preparation of patients sustaining intra-abdominal wounds consists chiefly of combating peripheral circulatory collapse and hypoxia with blood and oxygen. Response to adequate replacement therapy usually depends on the extent of wounds and the time interval after wounding. Plasma is not a substitute for blood but is ideal for elevating a lowered blood protein. Operative procedures on the colon are designed to divert the fecal current outside the peritoneum with provision of a stoma which can be closed extraperitoneally at a later date. Rectal wounds require adequate drainage of the posterior and perirectal spaces with proximal colostomy to prevent ascending infection into the peritoneal cavity. Sulfonamides and penicillin systematically administered are of inestimable value as adjuncts to early surgery in the treatment of abdominal wounds. However, early surgery skillfully performed is still the one most important single factor. Without it, none of the adjuncts will succeed. Topical application of sulfanilamide to the injured area is of very questionable value; in fact, it may even act as a foreign body. Observation of the abdominal cavity several days after operation has revealed a hard, whitish, and apparently non-absorbable mass. It is true that topical application of sulfanilamide often raises the blood sulfa level rapidly. However, the same may be accomplished by the intravenous administration of sodium sulfadiazine. It is possible that the newer adjunct, streptomycin, combined with early surgery, will further reduce mortality from abdominal injuries and may even alter some concepts of present day management. Severe shock, secondary to intra-abdominal wounds and particularly when complicated by concomitant wounds, is the dominant cause of death.

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## THE SURGICAL TREATMENT OF HYPERTENSION

W. GAYLE CRUTCHFIELD, M.D.

J. DE D. MARTINEZ-G., M.D.

University, Virginia

WE wish to present follow-up studies on 45 patients with vascular hypertension upon whom bilateral thoracolumbar sympathectomy was performed, and to emphasize the selection of cases for operation. Altogether we have done 156 operations on 81 patients, but only the group under discussion has been followed long enough for an evaluation of results. These 45 patients have been followed for periods ranging from 8 to 39 months.

This group contains our first consecutive cases, and consequently it includes many patients with advanced disease who would not be acceptable for surgical treatment under present rules of selection. The age range varied from 18 to 54 years, the average being 39 years. There were 19 males and 26 females. There were no surgical deaths in this series, but in the entire group there were 2 deaths, giving an operative mortality of 1.2 per cent, and a case mortality of 2.4 per cent.

Routine preoperative studies, which are listed in Table I, were made on all cases. Using available criteria, we tried for the most

TABLE I — PREOPERATIVE STUDIES ON HYPERTENSIVE PATIENTS

I. Funduscopy	IV. Vasomotor tests:
II. Cardiac Status:	Sodium amytal release test
Electrocardiograms	Cold pressor test
Orthodiagrams	Hyperventilation with carotid sinus pressure
III. Kidney Function tests:	Breath holding test
Blood urea	V. Blood pressure readings:
Urea clearance	Patient lying, standing and sitting
P. S. P.	
Concentration test	
Pyelography	

part to select favorable cases, but it must be admitted that many borderline cases and several cases showing definite evidence of advanced disease were operated upon, as no other method of treatment offered any hope of benefit.



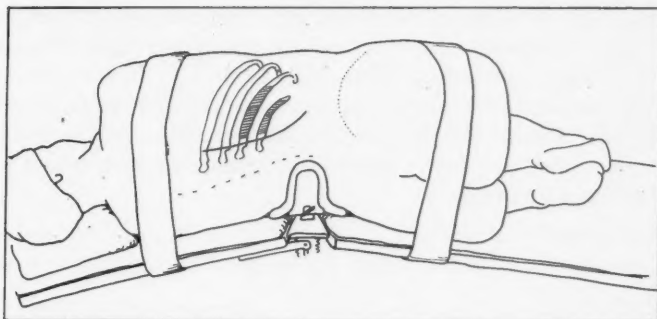


Fig. 1. Position of patient on the table for thoracolumbar sympathectomy. Shaded area shows portion of ribs removed.

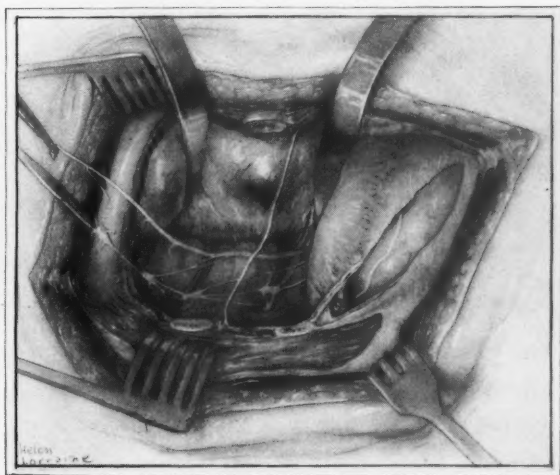


Fig. 2. Exposure of the sympathetic chain and greater splanchnic nerve in the lower part of the chest after partial removal of the 11th and 12th ribs. These nerves can be seen disappearing under the diaphragm. In the distal aspect of the wound, the perirenal fat can be seen through the opening made in the lumbodorsal fascia.

The operation in all cases was the Smithwick procedure<sup>1</sup> (figs. 1 and 2) which, for the most part, is a combination of the Peet<sup>2</sup> and Craig<sup>3</sup> operations. In the majority of cases, the operation consisted of removal of the sympathetic chain from T-9 to L-2 ganglion, inclusive, together with removal of a long segment of the greater

splanchnic nerve from the mid-thoracic region to the celiac ganglion, bilaterally. In some cases, removal of the sympathetic chain was more extensive, extending from T-8 to L-3 inclusive. In male patients, particularly in the younger group, it has been our routine to leave the second lumbar ganglion on one side, as it is believed that by doing so there is less danger of interference with sexual function, that is, ejaculation.

Having employed thoracolumbar sympathectomy in this series of cases, we therefore used Smithwick's method<sup>4</sup> of evaluating results.

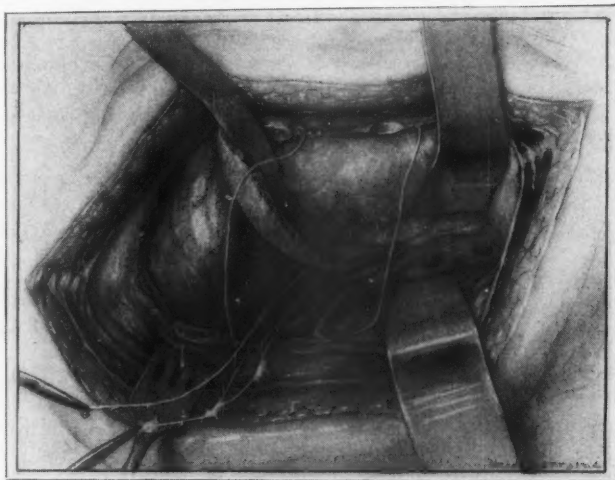


Fig. 3. Exposure of the celiac ganglion, 12th dorsal and first two lumbar ganglia. The diaphragm has been divided.

Smithwick divides his hypertensive patients into three types. Type I includes patients whose pulse pressure is less than one half the diastolic pressure, Type II—those with pulse pressure equal to or up to 19 mm. more than one half the diastolic pressure, Type III—those with pulse pressure 20 mm. or more above half the diastolic pressure. The effect of the operation is judged according to reduction of diastolic pressure. In Group I, he includes those cases in which there has been a reduction in diastolic pressure of 30 mm. or more; in Group II, those in which there has been a reduction in diastolic pressure of 20 to 29 mm.; in Group III, those in which there has been a reduction in diastolic pressure of 10 to 19 mm.; in Group IV, those in which there has been a reduction in diastolic pressure up to 9 mm., in Group V, those in which the diastolic pressure is higher than prior to operation.

Smithwick's results are a matter of record, and it will suffice to say that 79.4 per cent of his cases came within Groups I, II, and III, that is, they showed a drop in diastolic pressure, ranging from 10 to 30 or more millimeters. Our series is much smaller, but the results are comparable in that 50 per cent of our cases fell within these same groups. In support of our somewhat lower figure, a

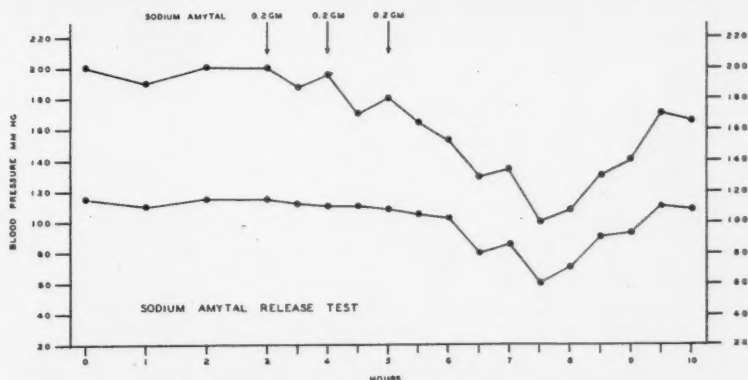


Fig. 4. A good release under sedation. This test should be performed at night when sleep is easy to induce. Profound sleep is necessary and usually this is produced by giving .2 Gm. (3 gr.) of sodium amytal for three doses at one hour intervals. In some cases, more drug may be required.

comparison of cases is indicated. Only 46 per cent of our cases came within Types I and II, that is, a favorable classification from the standpoint of projected results, whereas 61 per cent of his cases were in this category.

This analysis of results is of value in that it grades the effect of operation on diastolic pressure in a wide variety of cases. It fails, however, to show results which may be compared with normal blood pressure readings. For example, in a given case, blood pressure may be reduced from 260/150 to 180/120. This would be classified as a Group I result. Yet, it is obvious that this patient would still have hypertension of a severe degree. We have had such cases and in the classification which we will present, they have been regarded as having obtained poor results.

To present a clear picture of what may be expected from surgical treatment of hypertension, it seems that we should speak in terms of normal or essentially normal blood pressure. The relief of symptoms and improvement in the general condition of patients, who may show no substantial drop in blood pressure following operation, are very striking, and, therefore, must be regarded as desir-

TABLE II—POSTOPERATIVE BLOOD PRESSURE RESULTS

Series of 45 Cases Followed 8-39 Months

I. GOOD—ESSENTIALLY NORMAL BLOOD PRESSURE (B. P. 150/100 or less)	14 Cases 31.1%
II. FAIR—PERSISTENT HYPERTENSION OF MILD DEGREE Although there was a drop of 20-40 mm. in diastolic pressure, these patients had a persistent diastolic hypertension ranging up to 110.	9 Cases 20. %
III. POOR—PERSISTENT HYPERTENSION OF SEVERE DEGREE Patients in this group had reduction of diastolic pressure up to 40 mm. yet their diastolic pressure has ranged above 110.	23 Cases 48.9%

able results. However, the eventual security of surgical treatment of hypertension will depend upon its effect on blood pressure per se. Other changes in the condition of the patient should be looked upon as unexplainable side reactions, unless of course there is significant lowering of blood pressure to account for such improvement as diminution of heart size and favorable electrocardiographic changes. With this in mind, we have reclassified our results in relationship to normal blood pressure readings (Table II). Our cases have been divided into three groups—good, fair, and poor. We regard as having obtained good results those cases in which the blood pressure does not exceed 150/100, fair results as those in which there has been a substantial reduction of both systolic and diastolic pressure, but with a persistent diastolic pressure ranging up to 110, poor results as those in which the diastolic pressure remains above 110, even though many patients in this category have shown spectacular clinical improvement and marked lowering of blood pressure. With this simple classification, the percentage of so-called good results is not as striking, but the figures carry a greater meaning than those in some of the other current classifications.

*Selection of cases for operation.* Everyone interested in this subject has given much thought to the selection of candidates for surgical treatment, yet much confusion still exists. Before reviewing our cases critically, we were unable to predict with any degree of certainty the results of surgical treatment in a given patient. Smithwick<sup>4</sup> has called attention to the fact that patients with wide pulse pressure are not apt to respond favorably. This has been true in our experience, but, on the other hand, width of the pulse pressure has not been an infallible guide as to projected results. It is generally believed, and it is probably true, that females respond more favorably than males. However, in our small series, the good re-

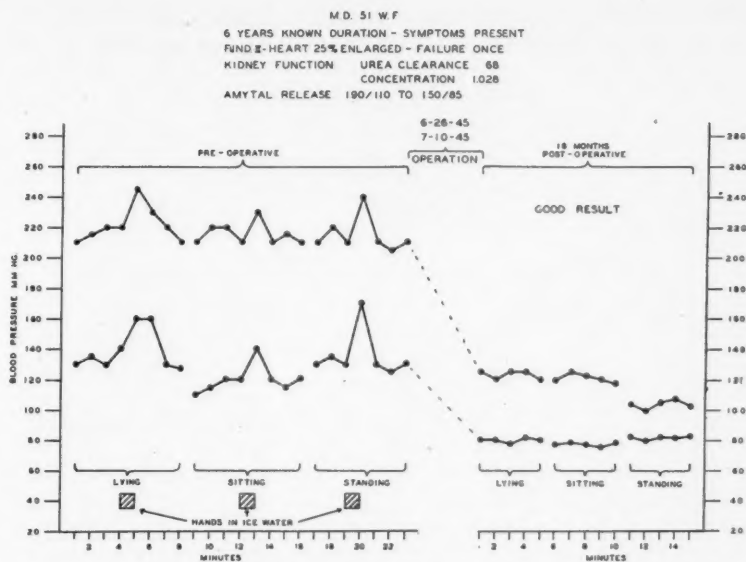


Fig. 5. This case record typifies a good result as classified in Table II.

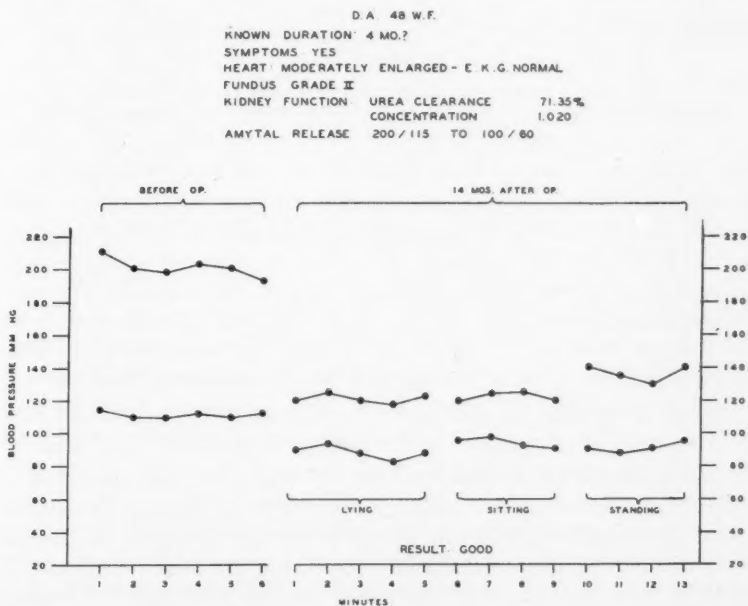


Fig. 6. This case record represents a good result. It will be noted that the pre-operative studies fulfill the criteria outlined in Table IV.

sults are equally divided between the sexes. Under 55, age does not seem to be an important consideration. Some of our best results

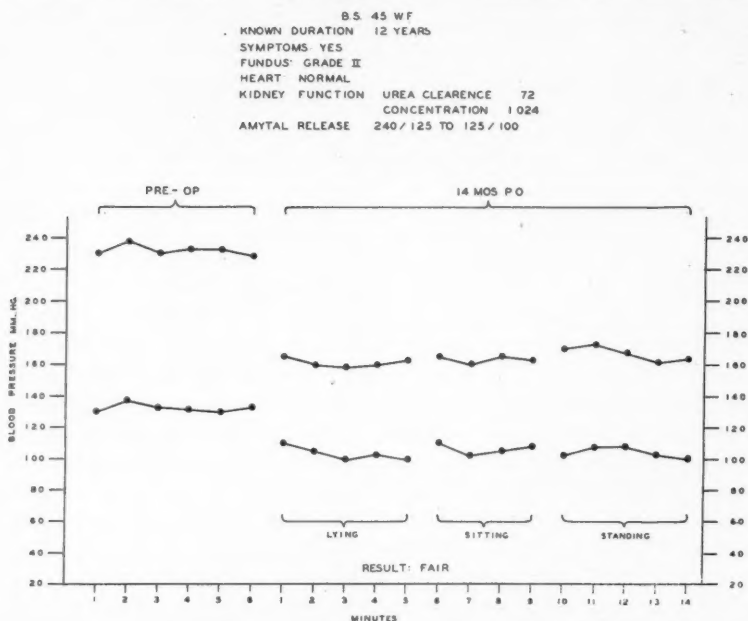


Fig. 7. This patient responded favorably to sympathectomy, but because of slight persistent diastolic hypertension, the result was classified as fair rather than good.

were in patients ranging from 48 to 52 years of age. Vascular accidents usually indicate serious vascular disease and, as has been pointed out by others, they generally lead to an unfavorable prognosis. The same may be said for patients who show more than grade II eye ground changes. Lowering of blood pressure under sedation, such as sodium amytal, and after bed rest, is desirable, but this response is only one factor in the selection of cases, as some patients with a rather stable blood pressure do surprisingly well.

While reviewing our postoperative results, we tried to find one or more common denominators to explain the successes and failures. The most consistent finding in those patients who failed to show a satisfactory drop in blood pressure was impairment of kidney function. Only one patient in our series who obtained a good result concentrated to less than 1.020, this being 1.019. Usually, the urea clearance was 50 per cent or more, and the PSP excretion was 60 per cent or more in two hours in those patients who were able to concentrate to 1.020 or above.



Most of our patients disclosed moderate to advanced cardiac disease. A history of failure was not unusual. Electrocardiographic

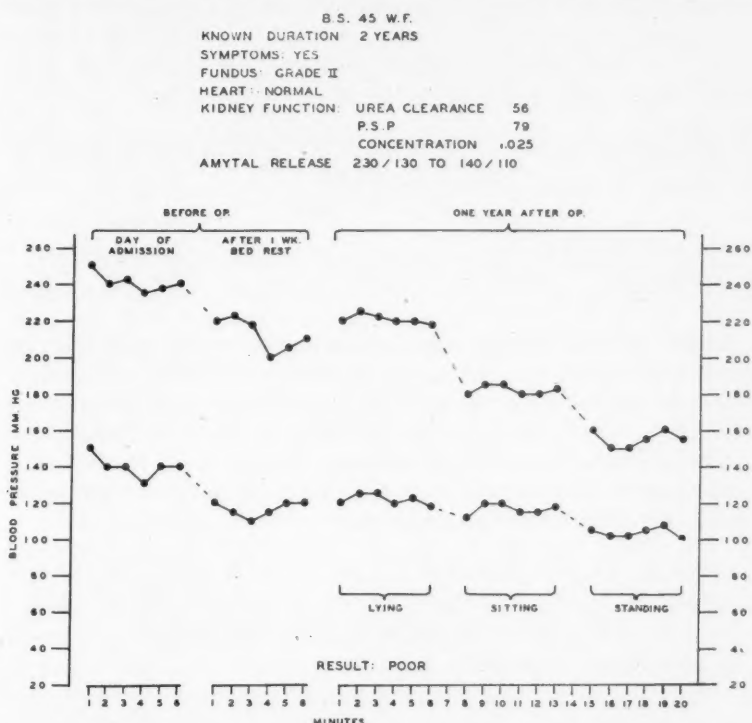


Fig. 8. Case record illustrating persistent orthostatic reduction of blood pressure. Marked clinical improvement in cases such as this may be attributed to intermittent lowering of blood pressure.

and orthodiagrammatic changes were very common. For the most part, these cardiac changes were attributable to prolonged hypertension, as evidenced by the fact that marked improvement in cardiac function occurred when blood pressure was lowered even temporarily. The condition of the heart, with few exceptions, has not been a contraindication for operation.

This study has led to our adoption of criteria as shown in Table IV for selection of the most suitable cases. Had we limited operation to patients fulfilling these requirements, 75 per cent would have obtained good results, that is, essentially normal blood pressure, as is shown in Table II, 20 per cent would have obtained essentially normal blood pressure, and only 5 per cent would have had to be placed in the poor result group.

The selection of cases, as outlined in Table IV, is critical, having been prepared to obtain the best possible candidates. These criteria automatically exclude most cases with extremely high diastolic pressure, that is, pressure of 140 or more which is almost always associated with impairment of kidney function. Furthermore, it eliminates many patients with extremely wide pulse pressure.

TABLE III — AVERAGE PRE AND POSTOPERATIVE BLOOD PRESSURE READINGS

Group of 45 Cases

Before operation (admission).....	223/134.5
After operation 8-39 months (office readings).....	154.3/106
Average reduction .....	68.7/28.5

While we wish to emphasize the selection of the most suitable cases for surgical treatment, we do not feel that all other cases should be excluded. In our opinion, there are three objectives to be considered: 1. To obtain normal blood pressure, 2. To bring about substantial reduction of blood pressure, leaving the patient with a mild degree of hypertension, and 3. To prolong life by producing orthostatic reduction of blood pressure.

TABLE IV — CRITERIA FOR SELECTION OF MOST SUITABLE CASES FOR BLOOD PRESSURE RESPONSE TO BILATERAL THORACO-LUMBAR SYMPATHECTOMY

- I. Age: Under 55, preferably under 50.
- II. Optic fundi: Minimal changes (Grade I or II).
- III. Vascular Accidents: None.
- IV. Normal Kidney Function:
  - Urea Clearance—50% (Minimum)
  - P. S. P. Excretion—60% in two hours (Minimum)
  - Concentration of urine—1.020 (Minimum)
- V. Release under sodium amytal to 150/100 (minimum) especially when pulse pressure is 90 or more.

There are many patients with little or no evidence of kidney damage who fail to meet one or more of the standards outlined in Table IV, yet they should be regarded as acceptable candidates for surgical treatment. These patients may not be able to concentrate above 1.018, respond poorly to sedation, have a wide pulse pressure, or give a history of having had a minor vascular accident, and yet respond favorably to sympathectomy. However, these patients should be regarded as borderline cases, and while the incidence of fair results may be high, the incidence of good results, according to

our criteria, will be appreciably lower than for those cases completely fulfilling all requirements.

We are definitely of the opinion that patients with a severe degree of kidney damage should not be subjected to surgical treatment. It is extremely unlikely that any patient unable to concentrate to 1.016 or above will derive sufficient benefit to justify such major surgery. We much prefer to operate on certain cases of malignant hypertension who show good kidney function, than to operate on patients with chronic hypertension who have marked reduction of kidney function.

Orthostatic hypotension is an almost constant finding in patients who have had an extensive bilateral thoracolumbar sympathectomy. This may last only a few weeks. On the other hand, it may persist for months or years. In many of our cases classified as poor results, orthostatic hypotension has been pronounced, and we feel that this has played a large part in the improvement that these patients have undergone. Even though the recumbent blood pressure has remained high, there has been diminution in heart size and favorable changes in the electrocardiograms. We feel that this improvement is due to a decreased load on the cardiovascular mechanism during the hours when the patient is in an upright position. Under the circumstances, we have at times, especially in cases of malignant hypertension, recommended sympathectomy to produce this effect. Some of these patients have shown marked improvement over a period of years, and have returned to a gainful occupation after having been bedridden for months.

#### SUMMARY

Follow-up studies on 45 patients operated upon for vascular hypertension have been presented and analyzed. As a result of this study, criteria for the selection of candidates for sympathectomy have been suggested.

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## SOME FACTORS IN THYROID SURGERY INFLUENCING MORBIDITY AND MORTALITY

GORDON S. FAHRNI, M.D., Ch.M., F.R.C.S. (C), F.A.C.S.

Winnipeg, Canada

**I**N the preparation of this paper the author's experience in thyroid surgery since 1927 has been reviewed. Allowing 3 years out of civilian practice while away on military service (1942-45) seventeen years are represented. Work in this field prior to 1927 has already been reported.

In the group since 1927 there are 4,954 patients all of whom underwent a subtotal thyroidectomy. Of these there were 2,430 toxic diffuse, and 2,524 nodular goiters, which group includes the non-toxic and toxic, as well as the malignant goiters. Surgery was not practiced in adolescent goiter.

### *Amount of Thyroid Tissue Removed*

In toxic goiter a fairly radical removal of both thyroid lobes was carried out, leaving only a small amount of thyroid tissue on each side of the trachea, immediately in front of the recurrent laryngeal nerves and the parathyroid bodies. Complete removal of the isthmus and pyramidal lobe was routine.

In nodular goiters a little less radical resection was aimed at, but seldom indeed did one feel justified in leaving intact a whole thyroid lobe even when it appeared normal to the eye and palpating fingers. One is usually rewarded in resecting such a lobe in finding small adenomas which may in the future grow larger even though the gross lesion in the other lobe has been removed.

### *Technic*

A comparatively short collar incision is used with free mobilization of the skin flaps on a plane between the platysma and sternohyoid muscles. Rarely are the strap muscles cut, but in large goiters where adequate exposure seems more difficult, no hesitation is felt in cutting one or both sides.

The skin wound is closed without drainage except in the occasional massive goiter, often substernal, when a Penrose drain is passed down to the dead space. Successful closure of the skin wound entails careful hemostasis. Occasionally some serum may accumulate beneath the skin on the fifth or sixth postoperative day. If

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aspiration is carried out to relieve this it usually has to be repeated several times, so that decompression by a hemostat is preferred and sound healing is hastened.

#### *Lugol's Solution and Thiouracil*

Lugol's solution has been used as a preoperative measure in all cases whether obviously toxic or not. Since resuming practice in October, 1945, thiouracil has been used preoperatively, only in the sicker than average toxic goiter patients. This is discontinued 9 to 10 days before the operation and the patient carried on Lugol's solution to the day of the operation.

Tribute should be paid to the efficacy of thiouracil in increasing the safety of operation in these very toxic people. Theoretically it should be used in all toxic goiters preparatory to operation, but the prolonged period of preparation—4 to 7 weeks—and the known safety of iodine preparation in the average toxic goiter, have influenced the author to use only the latter drug in all but the more toxic patients. This practice has been forced upon us largely on economic grounds. The added time, expense and hospitalization required in using thiouracil when hospital beds are so scarce and most patients come from a distance, makes its universal use economically impractical. The complications, particularly leucopenia and agranulocytosis, which may develop under thiouracil therapy make hospitalization during its use almost imperative.

#### *Recurrence*

On 213 patients, secondary operations have been performed for recurrent or persisting excess thyroid tissue with accompanying hyperthyroidism. If the case is a recurrent toxic diffuse goiter an attempt is made to do almost a complete removal of the hyperplastic thyroid tissue. Only in this way can the patient be reasonably and adequately protected against later excess hyperplasia. The operation, more difficult than formerly, is simplified by keeping in close contact with the true thyroid capsule and shelling the gland out, so to speak, picking up all arterial and venous branches before cutting them. If all other tissue is carefully shoved away from the thyroid lobe as it is shelled out, the parathyroid bodies readily adhere to the surrounding tissues and in a bloodless field the recurrent laryngeal nerves can more readily be protected.

The two chief reasons for doing a fairly radical removal of the thyroid at the first operation in all cases of toxic diffuse goiter are:

- (1) To cure the patient.
- (2) To lessen the tendency to recurrence.

All patients who have suffered from toxic diffuse goiter and who have had a resection of the thyroid gland are advised to take from 3 to 5 minims of Lugol's solution twice weekly for a number of months in the feeling that hyperplasia of remaining thyroid tissue may be a response to an insufficient iodine supply.

The 213 patients operated upon for recurrent hyperthyroidism in this series represent 4.3 per cent of the total number of thyroidectomies and 8.7 per cent of those having Graves disease. Of these 38 per cent had been operated upon primarily by the author and the other 62 per cent elsewhere.

#### *Carcinoma of the Thyroid Gland*

In this series are 46 patients operated upon for carcinoma of the thyroid, which of the total number is 0.9 per cent and 1.8 per cent of the nodular goiters. Other surgeons report a higher incidence of malignancy than this. Perhaps the discrepancy lies in the criteria of the different pathologists for making a diagnosis of carcinoma.

The most favorable type is the papillary carcinoma. In this type, if a fairly radical thyroidectomy has been performed before other structures have been invaded, radiation usually may be relied on to destroy or hold in abeyance further growth for long periods of time.

The malignant adenoma with sheets of cancer cells, sometimes scirrhous and sometimes grossly non-differentiated, is a more serious problem and only when removed early, before the adenomatous capsule is involved, may one feel hopeful as to a permanent cure even though radiotherapy be fully enjoined.

Carcinoma of the thyroid at this early stage is usually symptomless although the patient may have noticed a slight enlargement or increased firmness in his old goiter. Any such history should demand operation without delay and one will sometimes be rewarded in finding malignant changes in an adenoma that have not yet infiltrated the capsule. These are the patients that have come along over the years without recurrence.

The old aphorism "an ounce of prevention is worth a pound of cure" applies aptly to carcinoma of the thyroid; removal of the adenomatous goiter before malignancy develops would seem sound practice. Better still, prevention of adolescent goiter which is usually the forerunner of nodular goiter would seem a worthy task for public health authorities.

#### *Pregnancy*

It is not so long ago that pregnancy complicating hyperthyroidism



or vice versa was considered a serious situation and the question as to whether the woman should be carried through confinement in hyperthyroidism or have her pregnancy interrupted, or have her goiter removed, was one in which different opinions were given.

Experience has taught that when this situation is met with, the pregnancy should be ignored and surgical treatment of the toxic goiter carried out. Rarely indeed will the welfare of mother or fetus be compromised. In the last 3 months of pregnancy an exception to this rule may be made at the discretion of the obstetrician, consulting physician and the surgeon. The newer medical aids may give some promise in this field but in the past the author has advised and routinely carried out surgical treatment of the toxic goiter. Some 44 pregnant women have undergone thyroidectomy; there were no abortions; all went through their pregnancies satisfactorily. One baby was stillborn, but all the others were apparently normal.

#### *Diabetes and Hyperthyroidism*

The lower sugar tolerance of hyperthyroidism may lead to a spilling over of sugar in the urine. When this clears up following thyroidectomy, the patient should be considered a potential diabetic, even when the fasting blood sugar becomes normal. In true diabetes removal of a toxic goiter usually raises the sugar tolerance and simplifies the treatment of this medical disease. The usual preoperative and postoperative care, ordinarily exercised in surgery on diabetics, should be practiced.

#### *Organic Heart Disease*

Auricular fibrillation and later congestive heart failure is a common finding in late hyperthyroidism. Removal of the offending goiter may be expected to cure this condition by removing the toxic element and lessening the excessive load on the heart. When a normal heart becomes so incapacitated from hyperthyroidism, what can be expected of a heart afflicted with organic disease, either rheumatic or sclerotic in origin? For this reason it is all the more necessary to remove a toxic goiter when organic heart disease co-exists, with the reasonable assurance that removal of the hyperthyroid load may permit the patient suffering from mitral stenosis or anginal pains on effort, to become comparatively comfortable for some time at least.

#### *The Time to Operate*

In the operative treatment of hyperthyroidism, two of the greatest factors in the risk are the age of the patient and the age of the

disease. One might add a third, excessive loss of weight. Nothing much can be done about the first two, but it is important to increase the weight in these emaciated people before undertaking the operation, and this brings in the importance of increased well-balanced diets.

The judicious use preoperatively of Lugol's solution and thiouracil has already been dealt with but nothing has been said of the injudicious use of these drugs. For many years we have seen all too many really sick toxic goiter patients who have been taking iodine, usually in the form of Lugol's solution, for months or even years, and becoming steadily worse. These people present a real challenge to the surgeon, whereas they would have been good risks had they undergone operation about two weeks after beginning the drug. Let us hope that more discrimination and greater restraint will be exercised in the future in the use of drugs for the treatment of toxic goiters.

The author does not like operating on a bed-ridden patient if it can be avoided and this is perhaps never necessary in thyroid surgery. When those with congestive heart failure are compensated, even they seem to do better if up a little each day before operation.

Last but not least is the sense of well-being of the patient and his active cooperation and confidence.

#### *The Operative Dose*

This should be minimal and may be brought about by:

1. Anesthesia that will prevent pain and psychic stress, maintain a free airway, avoid anoxemia and toxic effects of anesthetic agents. The author's preference has been local anesthesia supplemented by very superficial cyclopropane and oxygen administration.
2. A short operation, easy handling of tissues, a bloodless field, protection of recurrent laryngeal nerves and parathyroid bodies.
3. Postoperative care:
  - a. Mental rest—established by reassurance and sedatives.
  - b. Fluid balance is brought about preferably by fluids per ora, supplemented when necessary by normal saline intravenously with or without 5 per cent glucose. Rarely should blood transfusion be needed.
  - c. Early ambulation gives the patient a gratifying sense

of well-being. In this series only one infarct of the lung and one pulmonary embolus were experienced. The paucity of pulmonary complications such as atelectasis and the comparative freedom from venous thrombosis and embolism is, the author thinks, attributable partly at least to the practice of getting the patient up in a chair the afternoon of the first, or not later than the second, postoperative day.

TABLE 1  
MORTALITY CHART

	Number of Operations	Deaths	Rate	Male	Female	Oldest	Youngest	Average Age
Toxic Diffuse	2,430	27	1.1%	8	27	74	12	46
Total	4,954	35	0.7%	7	20	72	12	43
Nodular Goiter	2,524	8	0.3%	1	7	74	30	55

#### COMMENT

The scope of this paper has permitted touching only on points that should be stressed on account of their practical importance, and because in classical surgical literature some of them have not been emphasized. The more commonplace matter of routine diagnosis has not been mentioned nor has the use and abuse of the basal metabolic rate with the need for intelligent interpretation.

Material has been drawn largely on a study of the group of cases mentioned. In 4,954 thyroidectomies, 0.7 per cent mortality rate was experienced, while in the last 425 thyroidectomies no deaths occurred. These latter cases were done in the past 16 months, the others prior to 1942. There is a common denominator in those before 1942 and since October, 1945, with one exception and that is the introduction of thiouracil in the past few years. This drug was used in all very sick toxic goiters in the last group and this is the type that provided the odd death before 1942.

In looking over the 35 deaths—1927-1942—in Table 2, 24 were due to thyroid crisis or ventricular failure. It would seem that many of these people might have lived had thiouracil or propylthiouracil been available for preoperative therapy.

These deaths represent the people who were quite sick, many of

TABLE 2

<i>No. of Cases</i>	<i>Cause of Death</i>	<i>Details</i>
10	Thyroid Crisis	Usual picture of restlessness—hyperpyrexia, racing and failing heart—usually seen in Graves disease.
14	Failing Heart	From 12 to 36 hours following operation pulse becomes poorer, with or without auricular fibrillation, and patient gradually sinks, usually becoming more dull and listless. Fever is not a pronounced factor. This picture is seen usually in older people who have had the goiter a long time, more commonly seen in nodular goiters. The autopsy findings are those of vascular degenerative changes particular in cardiac muscle.
4	Pneumonia	All did well for 3 to 10 days following operation.
2	Cerebral Thrombosis	One 6 days and one 2 weeks following operation.
1	Uremia and Liver Failure	An elderly female with a large goiter of long standing.
1	Sudden Death on Table	Sick boy 18 years of age, exophthalmic goiter. Cyclopropane oxygen anesthesia—death occurred suddenly, just after skin incision was made. Post mortem examination revealed a large spleen, a large thymus and a large vascular goiter with excess lymphoid tissue. The so-called "Status Lymphaticus" picture.
1	Anoxemia and Shock	This patient failed to react following cyclopropane and oxygen anesthesia—remained stuporous for 12 hours before death. Autopsy findings revealed petechial hemorrhage in gray and white brain matter.
1	Massive Infarct of Lung	A few days following operation. Death a few days later.
1	Pulmonary Embolus	A very sick man 51 years of age who sulkily refused to move about in bed or to get out of bed for 10 days following operation. He died suddenly grasping his chest in pain on the 10th day, as he got out of bed for the first time. Autopsy revealed a massive embolus plugging the pulmonary artery.

them for a long time, and although they all had improved somewhat on preoperative treatment, the residual thyrotoxicosis was sufficient to prevent the cardiac muscle meeting the stresses of operation. Had their basal metabolic rate been brought to normal for a short time by thiouracil therapy, a tremendous increase in ventricular reserve would have been established and the dangers of post-operative thyroid crises pretty well eliminated.

Had penicillin been available perhaps some of the 4 deaths from pneumonia might have been avoided.

Radioactive iodine is now on trial. What this and other newer drugs have as curative measures in toxic goiter and non-toxic goiter remains to be seen. In the meantime until hyperplastic goiters are removed as well as relieved of their hyperthyroidism by the use of drugs, and, until nodular goiters are prevented by first preventing or curing adolescent goiter, it would seem that there will still be a need for good thyroid surgery.

## VAGOTOMY IN THE TREATMENT OF PEPTIC ULCER

WARREN H. COLE, M.D.

LEROY WALTER, M.D.

and

JOHN REYNOLDS, M.D.

Chicago

THE immediate results of vagotomy for peptic ulcer as introduced by Dragstedt and associates<sup>1</sup> have been so favorable as to classify the work as epochal even though sufficient time has not yet elapsed for an appraisal of permanent results. Two or three decades ago the method was used in the surgical treatment of peptic ulcer by two or three surgeons, but with such poor results that the operation was abandoned, probably because the section of nerves was incomplete but particularly because the benefits of intestinal decompression were not then available.

### PHYSIOLOGIC DATA

The role of the vagus nerves in the secretion of gastric juice has been known for decades. In their animal experiments with an isolated stomach in which the blood and nerve supply were preserved, Dragstedt and associates<sup>2</sup> observed that the dog's stomach would secrete an average of 1100 c.c. of gastric juice with a free hydrochloric acid content of 0.35 to 0.42 per cent in 24 hours. However, after section of the vagus nerve in the chest, the amount was reduced to an average of 410 c.c. with a free acidity of 0.11 to 0.32 per cent. In their clinical studies they noted that the average total night secretion of gastric juice in ulcer patients was 821 c.c. with a free acid content of 47 and a total of 66 units; after vagotomy the night secretion was reduced to an average of 335 c.c. with a free acid of 15 and total acid of 46 units. Other investigators have corroborated this reduction in acid. For example, Grimson<sup>3</sup> had only one patient in 57 transthoracic vagotomies in whom the postoperative acid was more than 30 units.

Dragstedt and associates<sup>2</sup> have also noted that the increased tonus and hunger contractions in patients with duodenal ulcer were reduced but not abolished by vagotomy. Quite certainly this decrease in tonicity is the explanation of the prompt relief of discomfort following vagotomy in patients with duodenal ulcer. Healing

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From the Department of Surgery, University of Illinois College of Medicine, and the Research and Educational Hospitals, Chicago.

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of the ulcer would appear to have no influence on this reduction because it is noted by the patient as soon as he recovers from the anesthetic. There is a tendency for the development of diarrhea in many patients as will be discussed later.

Dragstedt and associates<sup>2</sup> have noted that vagotomy exerts no effect on the secretory response of the stomach to histamine or caffeine, but on most occasions abolishes the secretory stimulus ordinarily produced by the intravenous injection of insulin (Hollander<sup>4</sup>). This phenomenon therefore becomes useful in determining whether or not vagus section has been complete. Injection of 20 units of insulin in a normal adult will produce a sharp increase in the rate and acidity of gastric secretion, if the blood sugar falls to 50 mg. per cent or lower. If vagus section has been complete, no increase in amount or acidity of the secretion occurs. However, as has been emphasized by Moore,<sup>5</sup> this test is by no means infallible. It will be necessary to correlate final results with the test before an accurate interpretation as to its value will be available.

#### ANATOMY OF VAGUS NERVES AS RELATED TO THE ESOPHAGUS

All surgeons and anatomists are now aware of the great variation in the branching and relationship of the right and left vagus nerves. In a study of 100 autopsy specimens, Walters and associates<sup>6</sup> noted that the two nerves took origin from the esophageal plexus in 92 per cent of cases. In 64 cases various branches in the mid-portion of the esophagus converged to form 2 common trunks, one on the right and one on the left side of the esophagus. In 8 cases the nerves divided profusely at the diaphragmatic level thus constituting an anomalous condition which might make vagotomy by the abdomen approach difficult and incomplete.

In a similar study of 13 autopsies, Miller and Davis<sup>7</sup> noted that in only 3 instances did the two nerves progress downward through the esophageal hiatus as two common trunks without branching or abnormality of position.

In our dissections on the patients in the operating room we have likewise noticed a great variation in the position of the two main trunks. With few exceptions we have found no less than 3 trunks in all patients; the left vagus has branches more often than the right. In slightly over one half the cases the right vagus was found as a large trunk posterior to the esophagus without evidence of branching. Figure 1 illustrates the three most common types of formation as observed by us.

## INDICATIONS FOR GASTROINTESTINAL OPERATIONS ASSOCIATED WITH VAGOTOMY

Insufficient time has elapsed since the introduction of vagotomy to determine just when gastrectomy or gastroenterostomy should be performed concomitantly with vagotomy. However, certain principles may already be presented as being unquestioned. For example, if symptoms and x-ray reveal obstruction, some sort of intestinal operation, usually gastroenterostomy or gastrectomy, will be indicated along with vagus section. However, it is first essential

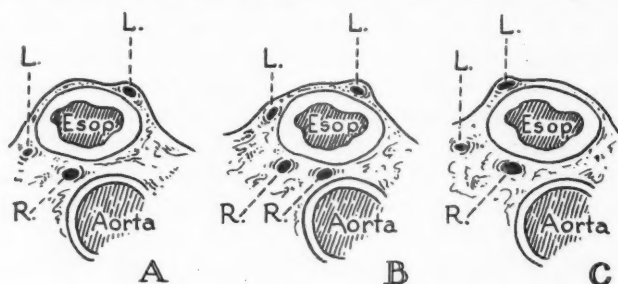


Fig. 1. Common types of distribution of vagus trunks as encountered by us utilizing the transabdominal approach.

to rule out pylorospasm. This can usually be done with proper feeding, medication and bed rest, sometimes associated with gastric decompression. If pylorospasm is present but can be eliminated by medical treatment, gastroenterostomy will not be indicated except perhaps in patients with large duodenal ulcers as discussed later. One of the most difficult problems will be the difficulty of deciding between gastroenterostomy or gastrectomy. In general, the age of the patient will be a factor in arriving at an answer to this question inasmuch as gastroenterostomy will be preferable in patients with low acid, marked obstruction, and in aged people. Gastrectomy will be more strongly indicated in young patients with high acid, and in those with severe intractability.

Another controversial point is the question as to whether a gastrectomy or gastroenterostomy should be done in patients with a history of hemorrhage from their ulcer but in the absence of obstruction. Since there is roentgenologic evidence that ulcers heal following vagus section, it would appear justifiable to perform vagotomy alone in such cases.

Results have been so favorable following vagus section in patients with gastrojejunal ulcers that vagotomy alone appears to be suffi-

cient to control this lesion. This is particularly fortunate since resection of the ulcer with the stoma is quite a formidable procedure though not associated with a very high mortality rate.

In general, results in gastric ulcer have not been as satisfactory as in duodenal. Walters and associates<sup>8</sup> report that one of two patients having vagus section alone for gastric ulcer developed a marked gastric distention which presumably might have been obviated by a gastroenterostomy.

#### OPERATIVE TECHNIC

At the present time there is considerable controversy as to whether the transthoracic or transabdominal approach to the vagus nerve is advisable.

**TRANSTHORACIC EXPOSURE.** It is agreed that areas can be found in the distal third of the esophagus where the vagus nerves show less branching than noted in the abdominal approach at the cardia. Theoretically, this would allow more complete isolation of the nerves and therefore a more complete neurectomy would be possible, although if the surgeon approaching the nerves from the abdominal side is meticulous in his dissection he would still encounter all major trunks. Exposure of the nerves is much more readily obtained by the thoracic approach than by the abdominal. The chief disadvantage of the thoracic approach lies in the fact that complications will probably be more frequent than following transthoracic neurectomy. However, the thoracic pain commonly observed in thoracotomy can be minimized greatly by making the incision between the ribs instead of doing a rib resection. Numerous surgeons, including Grimson,<sup>3</sup> Miller and Davis<sup>7</sup> and others, prefer this approach.

*Technic of transthoracic vagotomy.* A long incision is made through the 8th interspace and the inferior pulmonary ligament cut. The lung is held upward with a pack and the peritoneum over the esophagus incised. By blunt dissection, using the index finger, the esophagus can be mobilized satisfactorily with little difficulty. Although branches are invariably found between the two vagus nerves, exposure of the main trunks and these branches is rarely difficult. The right and left trunk are transected, removing a segment 2 to 4 cm. long. All communicating branches at the level of the transection should likewise be cut along with numerous nerve filaments. It appears desirable to ligate the ends of the major trunks, but it is doubtful that they need be buried under adjacent tissue.

**TRANSABDOMINAL APPROACH.** Because so few post-operative complications related to the celiotomy alone have been encountered following abdominal operations for vagotomy, many surgeons, including Walters and associates, Dragstedt and associates and the present authors, favor the abdominal approach, particularly since there are other advantages as listed below. The advantages of the transabdominal approach may be listed as follows:

1. Exposure from the abdominal side allows complete confirmation of the diagnosis. This becomes quite important particularly since even expert radiologists admit a significant error in the diagnosis of peptic ulcer, including particularly gastrojejunal ulcer.
2. A fairly accurate estimation of the degree of pyloric or duodenal obstruction can be obtained, and an anastomotic operation performed if indicated.
3. The abdomen can be explored for other unrelated lesions. The necessity for such an exploration has been emphasized by a patient reported by Walters and associates, in whom hemorrhage presumably caused by peptic ulcer was in reality caused by a Meckel's diverticulum.
4. When the ulcer is in the stomach it can be inspected, palpated and actually examined grossly (and microscopically) by incising into the stomach. The ulcer can also be removed if it appears that local or radical excision is indicated.

The disadvantages of the abdominal approach lie in two factors:

1. The difficulty of exposure on certain occasions.
2. Anomalies in position and branching of the nerve. It should be stated, however, that as the experience of the surgeon increases, he will encounter very few cases indeed in which exposure is really difficult. However, it is always necessary to extend the incision high into the epigastrium up to the point just to the left of the ensiform, as suggested later. As Walters has emphasized, there will be so much branching of the nerve inferior to the level of the diaphragm in about 8 per cent of cases that it will be extremely difficult to be sure that all fibers have been cut in this group of cases. The authors have practically never failed to find at least three major trunks at the cardiac level.

*Technic of transabdominal approach.* The incision should be started high in the epigastrium just to the left of the ensiform and carried downward. The authors prefer to carry the incision obliquely across the midline to the right of the umbilicus, incising the

fascia of the rectus muscle on the right (fig. 2). If exposure of the duodenal stump is difficult during gastric resection, this incision can be extended downward or obliquely cutting perhaps half the rectus

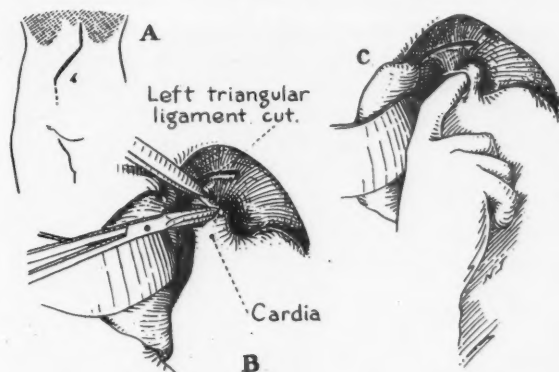


Fig. 2. Technic of transabdominal vagotomy. A, The incision is started high and to the left of the midline to allow exposure of the nerves; if there is probability that gastrectomy will be necessary, the incision is extended obliquely to the right to allow good exposure for closure of the duodenal stump. B, The triangular ligament is cut and the peritoneum over the cardia is incised. C, The terminal end of the esophagus is mobilized with the index finger.

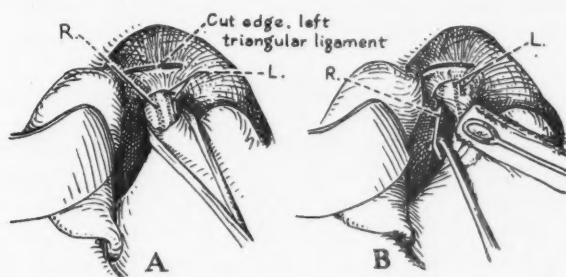


Fig. 3. Technic of transabdominal vagotomy continued. A, A Penrose drain is placed around the esophagus for gentle traction. B, Nerve trunks are identified by direct vision or palpation, and pulled forward into full view for resection and ligature of their ends.

muscle without jeopardizing wound healing. After exploring the stomach and duodenum along with other important organs, the upper abdomen is exposed and the triangular ligament of the left lobe of the liver cut. The peritoneum over the cardia is then incised transversely and the index finger inserted beneath the peritoneum, encircling the esophagus on both sides. The finger encounters the aorta on the inferior side and should attempt to include all the

areolar tissue possible with the esophagus since nerve trunks can probably be identified easier when lying adjacent to the esophagus than when penetrating the surrounding tissue. After encircling the cardiac end of the esophagus with the finger, a penrose drain is inserted through the opening and mild traction maintained. Search is made first on the anterior surface of the esophagus, cutting through all fine filaments and excising the major nerve trunks. The ends of the major nerve trunks should be ligated with silk or cotton. The esophagus is then rolled upward and outward with a sponge stick or blunt instrument so that the inferior surface can be inspected. Almost invariably the right vagus, or the major trunk will be encountered on the inferior surface about  $\frac{1}{2}$  inch from the right margin of the esophagus. It may be attached to the wall of the esophagus or may be in the areolar tissue which has been separated posteriorly by the blunt dissection. It can be picked up easily with a blunt hook, transected and a piece removed. Palpation with the finger will assist the surgeon in finding the other major trunks. He should look on the medial side for trunks which leave the right vagus at the diaphragmatic level penetrating the superior margin of the gastrohepatic omentum and finally entering the lesser curvature. After all trunks and fibers are cut, additional operative procedures as indicated may be performed. It is advisable to close the opening in the peritoneum over the cardia, but it is doubtful that this procedure is very important.

#### RESULTS OF VAGOTOMY FOR ULCER

**SYMPTOMATIC RESULTS.** In general, all surgeons are obtaining a high percentage of symptomatic relief following vagotomy for ulcer. For example, in 13 of 14 patients having gastric neurectomy for ulcer without other operative procedures as reported by Walters and associates,<sup>8</sup> results were considered satisfactory; the ulcer was duodenal in 10 patients, gastric in 2 and gastrojejunal in 2. Moore<sup>9</sup> reports satisfactory results in 90 per cent of cases. In a study of 57 cases Grimson<sup>7</sup> noted good results in 37 per cent and fairly good results in an additional 44 per cent; in 6 cases of gastrojejunal ulcer, the ulcer healed following vagotomy. In our own series of 30 cases, 90 per cent had results which we would classify as good or excellent. Although ulcer symptoms disappeared in practically all of the remaining cases, most of them developed complications of one type or another as discussed later. We performed vagotomy in 3 patients with gastrojejunal ulcer. In two of the three patients symptoms were severe, but disappeared promptly after operation. In the third patient vagotomy was performed for recurrent



hemorrhage; symptoms were minimal at the time of vagotomy.

**COMPLICATIONS.** Numerous complications have been reported following vagotomy although most of them are transitory.

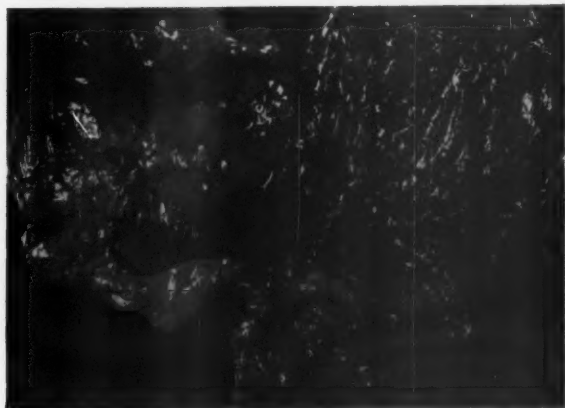


Fig. 4. Autopsy specimen showing healed ulcer at gastrojejunal stoma 9 months after vagotomy. (Arrow points to healed ulcer.) The patient died of a widespread pulmonary carcinoma of indeterminate origin. In this patient the symptoms produced by the active gastrojejunal ulcer were very aggravating, but were entirely relieved by the vagotomy as soon as one day following operation.

1. *Dilatation of the stomach.* This is perhaps the most frequent complication noted, although on most occasions the patient is unaware of the abnormality. Grimson<sup>3</sup> noted a variable amount of dilatation in 37 per cent of his series of 57 patients. The most common symptoms occurring with this complication are belching of foul gas and discomfort in the epigastrium. Vomiting is not common except when considerable obstruction is present. Walters and associates<sup>8</sup> report that they noted gastric retention in 4 of 14 patients who had gastric neurectomy in the absence of an anastomotic procedure. In 15 patients having gastroenterostomy in addition to vagotomy, 4 had delayed emptying; one of those required a jejuno-jejunostomy before relief could be obtained. Since the complication is so common it becomes essential to decompress the stomach following vagotomy in all patients. The present authors maintain decompression for 3 to 6 days and, after a fast of 6 to 10 hours with the tube clamped, aspirate the stomach to determine the amount of retention before removing the tube. If retention measures less than 75 to 100 c.c. the tube may be removed. However, the patient must be watched closely and the tube put back to test the patient for

gastric residue if the slightest symptoms of dilatation develop. In our opinion prolonged postoperative decompression will sharply minimize the incidence of gastric retention and dilatation. We always pass an Abbott-Rawson tube before operation and, when an



Fig. 5. Six hour gastric residue following barium studies in a patient who had a vagotomy 9 months previously. Gastric residue of variable degree had been demonstrable by x-ray a few weeks after operation. Symptoms were extremely mild but gastroenterostomy was finally performed with complete subsidence of symptoms. At operation a duodenal stenosis produced by healing of the ulcer was found.

anastomosis is performed, thread the end of the tube through the stoma, just before closing the inside row of sutures. In this way we are able to decompress the stomach and inject a liquid diet into the jejunum; this obviates the necessity of intravenous fluids except perhaps for the first day or two. After this time ample food can be injected into the jejunum to maintain caloric needs.

It is obvious that atony of the stomach as well as obstruction at the pylorus or duodenum may give rise to dilatation. It is essential that we differentiate between these two factors and ascribe the correct etiologic factor to the condition since the treatment will be dif-

ferent in the two groups. For example, stimulating drugs such as urecholine are indicated when the dilatation is caused primarily by atony. Grimson<sup>3</sup> and others have used the drug under such circumstances and have noted definite improvement in the motility of the



Fig. 6. Six hour gastric residue following barium studies in a patient who had a vagotomy performed 12 weeks previously for duodenal ulcer. The patient is asymptomatic and gaining weight.

stomach following its use. The six hour retention which is encountered now and then will be improved markedly or eliminated unless significant obstruction is present.

2. *Obstruction at the pylorus or duodenum.* Mechanical obstruction may presumably be caused by scar resulting from healing of the ulcer or by pyloric spasm. It may be extremely difficult to distinguish one from the other. We have had 3 patients with obstruction or atony. Two of these were so severe that a secondary operation was performed; in each case only a vagotomy was performed at the original operation. In both patients the scarring incident to healing of the ulcer had reduced the lumen of the duodenum to less than half of its original size. It is very significant that barium fill-up of

the stomach in these patients before operation revealed duodenal deformity but no 6 hour residue. Within a few weeks following vagotomy, the patients began to complain of anorexia, fullness and discomfort in the abdomen. In one patient obstruction was so severe that gastroenterostomy was necessary 6 weeks after operation. In the other patient symptoms did not progress so rapidly; x-ray examination 3 months after vagotomy revealed considerable 6 hour retention which persisted in spite of the fact that symptoms were so mild that no radical therapy appeared indicated. However, at the end of 9 months postoperatively, the obstruction, though very mild symptomatically, was still demonstrable by x-ray (fig. 5); gastroenterostomy was therefore performed. As stated, operation revealed an obstruction caused by scar at the site of the ulcer; presumably healing of the ulcer had produced stenosis. Gastroenterostomy relieved the patient. The third patient has a mild 6 hour retention but is entirely asymptomatic. We wish to emphasize that ulcers heal primarily by scar formation (particularly when healing rapidly) and when a large ulcer heals, sufficient scar may be formed to produce obstruction. In the presence of a large ulcer it is probably good judgment to do a gastroenterostomy, anticipating dense scar formation with stenosis later.

3. *Persistence of ulcer or development of new ulcer.* Since the cause of the ulcer is presumably not removed by vagotomy, an occasional complication of this type would be expected. Grimson<sup>8</sup> reports the development of a gastric ulcer following a vagotomy; however, it healed under medical treatment. Walters and associates<sup>8</sup> report that of 3 gastric ulcers excised, one recurred; hemorrhage and considerable dilatation developed in this patient. Vagotomy is definitely less effective in gastric ulcer than in duodenal ulcer.

4. *Diarrhea.* This is a fairly common complication but varies greatly in the different reports. Moore reports it in 62 per cent of 74 cases. Harper and Dragstedt<sup>2</sup> report an incidence of 50 per cent of diarrhea (not permanent) if vagotomy alone was done, but an incidence of 15 per cent if gastroenterostomy was done at the time of vagotomy. It was much less common in our series (3.3 per cent).

5. *Chest pain.* Obviously, this complication will occur only in patients having vagotomy by the transthoracic approach. Although it was relatively common in the earlier reports when a rib was removed, it is becoming much less common now that the chest is opened by an incision between the ribs. The latter incision will obviously involve the intercostal nerves much less frequently. In the 4 patients upon whom we performed transthoracic vagotomy one

TABLE 1. SUMMARY OF PATIENTS HAVING VAGOTOMY

Type and No. of Cases	Type of Incision	Results	Complications
Vagotomy alone 11	Trans thoracic	Excellent .....9	2 Cases Duodenal ulcer stenosis with obstruction requiring gastroenterostomy at 9 months following transthoracic vagotomy and 6 weeks after an abdominal vagotomy.
	....7	Fair .....1	1 Case Transient diarrhea.
	Abdominal ....4	Failure .....1*	1 Case Asymptomatic but has considerable gastric residue on five hour film 1 year postoperatively. This case had postoperative regurgitation interpreted at x-ray as relaxed cardiac sphincter but it disappeared in a month.
Vagotomy and Gastroenterostomy 6	Abdominal ....6	Excellent .....4	1 Case of apparent cardiospasm. Relieved by several mercury bougie dilatations. Asymptomatic now (6 months later).
		Good .....2	1 Case unusually persistent and recurrent gastric atony postoperatively requiring prolonged gastric decompression (15 days). Asymptomatic now.
			1 Case Asymptomatic, but x-ray shows 40 per cent retention at 6 hours on x-ray.
Vagotomy and Gastrectomy 10	Abdominal ....10	Excellent .....10	1 Case Sense of epigastric fullness for 3 months postoperatively. Then spontaneously disappeared.
	Abdominal...2 Trans thoracic...1	Excellent .....2 Good .....1 (ulcer pain cured but chest pain)	1 Case Thoracotomy incisional pain persistent for 7 months.

\*This patient listed as a failure was one having vagotomy for a "peptic" fistula at the junction of a skin tube and stomach. (Operation performed for benign stricture of the esophagus.)  
The results in column 3 are "ultimate." There was temporary delay in results as described under complications.

(with rib resection) complained for several weeks of severe pain radiating along the course of the scar and downward. This is one of the factors which has led us to adopt the abdominal approach.

6. *Miscellaneous complications.* Of other complications which may be encountered following vagotomy, one described by Weeks and associates<sup>9</sup> as vagovagal reflex is the most serious, though rare. They reported a bradycardia and marked cardiac irregularity following isolation and section of the right vagus; shortly thereafter the heart stopped beating. Although a feeble beat was obtained after cardiac massage, the patient died within a few hours after operation. A similar case is reported by Moore and associates.<sup>10</sup> Since their experience, the latter authors routinely anesthetize both vagi above the point of manipulation with procaine and give large doses of atropine before or during the operation. One of our patients complained that difficulty in swallowing developed several weeks after operation. X-ray revealed a definite lag of the barium column at the cardia, suggestive of cardiospasm. However, all symptoms disappeared after several esophageal dilatations.

**MORTALITY RATE.** In approximately 200 patients upon whom vagotomy was performed, Dragstedt<sup>11</sup> reports 1 death with a mortality rate of 0.5 per cent. Grimson<sup>3</sup> reports 1 death in 57 vagotomies (1.7 per cent). Walters and associates<sup>8</sup> report 1 death in 40 patients (2.5 per cent). We have had no postoperative deaths in 30 vagotomies. Obviously, the mortality rate will improve as experience with the operation increases. It may be assumed that a mortality rate of less than 1 per cent may be expected. With the exception of deaths from vagovagal reflex, most of the fatalities should be ascribable to the celiotomy and not to the vagotomy.

#### SUMMARY

Good results will be obtained in 80 to 90 per cent of patients having vagus section for peptic ulcer although insufficient time has elapsed to determine whether or not the results are permanent. Vagotomy appears to be particularly effective against gastrojejunal ulcer. Numerous complications, including gastric dilatation, diarrhea, persistent or recurrent ulcer, thoracic pain (following trans-thoracic approach) and vagovagal reflex have been reported as complications of the operation. The former (gastric dilatation) is reported as being one of the most common, although the authors noted it in only 10 per cent in their series of 30 cases.

Gastric retention is common following vagotomy. It may be produced by atony or actual stenosis at the site of the healed ulcer.



In the authors' series 2 patients developed so much obstruction that gastroenterostomy was necessary; a third patient has a slight 6 hour gastric retention but is asymptomatic. The authors are convinced that prolonged gastric decompression for 3 to 6 days will markedly decrease the incidence of gastric retention, particularly that due to gastric atony; feeding is maintained during decompression by injecting food through the "injection" lumen of an Abbott-Rawson tube inserted before operation and threaded through the stoma at the end of the operation. However, elimination of gastric retention in all patients cannot be expected because obstruction may result from the scar by healing of the ulcer if gastroenterostomy was not performed at the initial operation. Therefore, it may be advisable to perform a gastroenterostomy along with vagotomy when the ulcer is large.

The most serious reaction is cardiac and respiratory paralysis arising from vagovagal reflex; it may result in a fatality but fortunately is very rare.

The mortality rate should be less than 1 per cent. We have had no deaths in our series of 30 cases in whom gastrectomy was performed in 40 per cent of cases. It is probable that gastric resection is not necessary in such a large percentage of cases as enumerated above. However, at the time of operation, resection appeared to give us more assurance of satisfactory results, particularly since most of these patients had very high gastric acidity; moreover, the permanency of vagotomy effects has not yet been established.

We prefer the transabdominal operation, but wish to emphasize that if this approach is utilized, meticulous search must be made for minor and major branches of the two vagus nerves. In fully 90 per cent of our cases performed transabdominally, we found 3 or more major vagus trunks.

Although results have been good following vagotomy for ulcer and the authors are optimistic about the permanent results, we wish to emphasize that wholesale adoption of the procedure by all surgeons for all types of cases must not occur until sufficient time has elapsed for a correct appraisal of the permanent results.

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## A METHOD OF STUDY OF THE UTERINE CANAL

W. B. NORMENT, M.D.

Greensboro, N. C.

UTERINE bleeding may be caused by an endocrine dysfunction or may be mechanical in origin. During the past several years much progress has been made in determining the cause of uterine bleeding from an endocrine viewpoint. However, there has been very little done to determine the cause from the mechanical viewpoint. It is true that hystero-grams, as an aid to the diagnosis of polyps and submucosal myomas, have been used more in recent years. Previously, however, the diagnosis of polyps and submucosal myomas was entirely by the curette, which was very inaccurate. This paper will deal entirely with an aid to diagnosis of submucosal myomas, polyps and malignancy of the fundus of the uterus by hystero-grams and by direct observation.

Since the uterus is such a common site of polyps and submucosal myomas it would seem that a hystero-gram of the uterus should be almost a routine procedure in any case of irregular uterine bleeding. Other organs or tracts of the body, as the gastrointestinal tract and the urinary tract are routinely studied by x-ray in an attempt to locate the point of bleeding from these respective tracts, and yet tumors are much more prevalent in the uterus than in any other organ of the body. The routine bimanual examination of the uterus in which large subserosal myomas may be palpated has previously been the extent of investigation of tumors of the uterus. It is true that often the large subserosal myoma of the uterus is not a necessary cause of uterine bleeding, particularly if the subserosal myoma does not protrude into the uterine canal. Submucosal myoma protruding into the uterine canal may be impossible to detect by the routine bimanual examination. After curettage of these uteri it is very difficult to state definitely whether the patient has a submucosal myoma or a polyp. Many patients have been curetted repeatedly and submucosal myomas and polyps not diagnosed. These patients are often treated on an endocrine basis when the cause of the bleeding is purely mechanical.

### METHOD OF STUDY

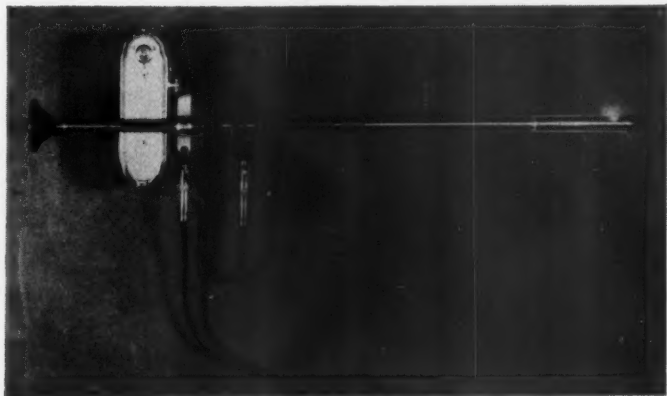
This method of study is a combination of (1) the hystero-gram and (2) direct vision and indirect vision. The hystero-gram was first used by Rindfleisch<sup>1</sup> thirty-five years ago. Later Rubin<sup>2</sup> and others used silver salts for this purpose. Then followed shortly thereafter the use of polygens, and more recently, since 1922, the

use of iodized oils. Until recently the iodized oils were used entirely; however, there are some objections to the use of these oils, due to the fact that they have a definite tendency to become stagnant in small channels and crevices of the mucosa and Fallopian tubes. The iodized oils are also nonabsorbable, will leak through the Fallopian tubes into the abdominal cavity and remain there for a number of years, resulting oftentimes in multiple adhesions of the pelvis. Rubin lists the prerequisites for an ideal opaque contrast medium as follows: (1) Adequate opacity, (2) Rapid absorbability, (3) Freedom from chemical irritation, and (4) Proper viscosity. One of the media which approaches these requisites is Rayopake.<sup>3</sup> This product is an opaque contract medium containing an organic iodine compound and a polymetric form of alcohol. The alcohol substance renders the compound viscus. Since the medium is of very low toxicity and is rapidly absorbed it makes an ideal medium for x-ray study of the uterine canal. Rayopake may be injected directly into the uterine canal by the use of the plastic cannula, or in those patients where uterine bleeding continues, and it is difficult to inject the Rayopake, then it is advisable to dilate the cervix and use an intrauterine bag.<sup>4</sup> The uterine bag is constructed by using a Pezzer catheter over which a rubber tissue bag is tied with a silk suture. The bag is inserted into the uterus, the Pezzer catheter making it impossible for the patient to expel the bag during her reaction from anesthesia. After the bag has been well inserted into the uterine canal, Rayopake may be instilled into the bag, the end of the catheter clamped and various x-ray studies made to see if there is any polyp or submucosal myoma projecting in the uterine canal. However, since most patients do not require the uterine bag, the usual routine injection of Rayopake into the uterine canal with the plastic cannula is most often used. In the occasional patient whose rather profuse uterine bleeding makes it necessary to use the uterine bag, it may be left in the uterine canal and inflated with air to act as a hemastatic agent to control uterine bleeding, similar to the bag used in the suprapubic prostatectomy. Forty-eight hours later the air is released from the uterine bag, and if there is not further bleeding the bag is removed. This procedure is more simple than that of former methods of packing the uterine canal with gauze. There is not the secondary foul discharge and fever that usually accompanies the packing of the uterine canal with gauze to control bleeding.

Media used in a hystrogram should not be very dense, as the iodized oils often are. Rayopake is much less dense and makes a more satisfactory medium due to the fact that submucosal myomas

and polyps will more likely be shown through this medium than the very dense iodized oils.

The plastic cannula has several advantages over the former metal cannula. The plastic cannula is semi-pliable. The tip is very pliable and bent at different angles and more easily inserted into the cervix, which is difficult to catheterize on some occasions. In the



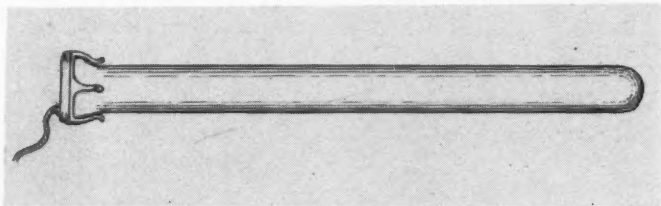
At the end of the optical instrument is attached a camera for photography of the interior of the uterus.

patient with a small vaginal vault, the cervix pointing directly backward, it is very difficult to insert the cannula because of obstructing view with the acorn on the metal cannula. Also the metal cannula, and rubber acorn, being opaque, makes it impossible to get a clear hystrogram. At times the uterus, being slightly retroverted, will fall back of the cannula and the cannula will be revealed in the x-ray over the site of the dye in the uterine canal, making it necessary for the patient to return in an attempt to make other views so that the cannula will not be an objectional factor. This is eliminated entirely by use of the plastic cannula, as it is non-opaque to x-ray and is much more pliable and easier to insert into the uterine canal.

The cannula is composed of Polythene or may be made of any other non-opaque plastic material that has the properties of Polythene. Polythene has very good thermal properties—it will maintain its form up to a temperature of  $104^{\circ}\text{C}$ ., or  $290^{\circ}\text{F}$ . It is also desirable due to the fact that it has a very low water absorption and a low rate of transmission water vapor. This plastic is also very resistant to chemicals and makes an ideal material for sterilization by chemicals or by heat.

## DIRECT VISION AND INDIRECT VISION

The second method of study is by direct vision and indirect vision. This method is also used as an aid to detect submucosal myomas and polyps, but more important to aid in the diagnosis of carcinoma of the fundus of the uterus. The hystero-gram is a very simple method of diagnosing submucosal myomas and polyps, but also the hystero-gram may be confirmed by direct vision. However, direct vision is more important in detection of carcinoma of the fundus of the uterus. In growths of the breast and other organs, as little



Normont plastic sheath for direct and indirect vision. The lights are located at the open end of the sheath, the light being transmitted through the walls of the sheath to the opposite end. The light is not reflected. A forward vision optical instrument or a lateral view may be used.

handling of the growth as possible in its removal is always observed, due to the fact that trauma to the growth in its removal may disburse the malignant cells to the lymphatic channels. However, a patient with carcinoma of the fundus of the uterus is routinely curetted for diagnosis and most likely by severe curetting many cells are scattered throughout the lymphatic channels. If a less radical method, as direct observation, in an attempt to diagnose malignancies of the fundus of the uterus were employed, and in those doubtful cases where direct vision could not be relied upon, then a curettage of the uterus, probably better results would be obtained in these patients.

For many years various instruments have been constructed in an attempt to view the interior of the uterus. Several years ago the author published a method<sup>2</sup> whereby the interior of the uterus could be visualized by the attachment of a transparent rubber bag over the end of an optical instrument. This was used in the human but was not entirely satisfactory due to wrinkling of the bag in the small uterine canal, and the poor visibility through the rubber tissue. During the past 2 years the author has used the transparent sheath which had many advantages over the rubber tissue bag. The tube is composed of a plastic which is very transparent and highly



polished on the exterior surface so that blood will not become adherent to the tube. It is also necessary that the plastic tube fit snugly over the optical instrument to insure better vision. The plastic tube has other advantages. In viewing the interior of the uterus it is necessary to have a supporting structure, as in the retroverted or anteverted uterus, if not adherent, may be held at a 45° angle by the insertion of the transparent plastic sheath. Held in this position the optical instrument is then inserted into the plastic tube and a thorough study made of the entire uterine canal. With the plastic tube, or sheath, the entire circumference of the uterine canal may be visualized as it prevents adherence of blood to the lens and light of the optical instrument. There is very little trauma in insertion of the plastic tube into the uterine canal. The usual routine vaginal preparation, some type of anesthesia such as pentothal sodium, following which the cervical canal is dilated, the plastic tube inserted, followed by insertion of the optical instrument through the plastic tube. If it is very evident that the patient has carcinoma of the fundus of the uterus from gross examination of the uterine canal, then it is not advisable to curette the uterine canal. If, however, there is any doubt, then of course curettement of the uterine canal is necessary, before any further procedure. Due to its simplicity it is advantageous in combination with a hystero-gram in diagnosing malignancies of the fundus of the uterus and also polyps and submucosal myomas.

This method of examination of direct vision and indirect vision has also been used in examination of the rectum, particularly in those patients where it is very difficult to insert an anoscope.

This method of study of the uterine canal, by hystero-gram, with Rayopake, direct and indirect vision combined, will aid greatly in diagnosis of benign and malignant growths of the uterus, with greater safety to the patient.

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## SUMMARY OF RESULTS FROM EXPERIMENTAL USE OF A NEW VASOPRESSOR DRUG

THE medical profession has been searching for many years for a satisfactory vasopressor drug for use in cases of a sudden fall in blood pressure in patients during hemorrhage, shock, and in deep anesthesia. Since the advent of the more universal use of spinal anesthesia in general surgery, the need has become more urgent for the discovery of such a drug. Epinephrine 1 to 1000 solution in doses of 15 to 20 minimums has been used for a long time but the effect of this drug is of such short duration that it has very little value. Ephedrine in 50 mg. doses produces a rather rapid rise in blood pressure and the effect is sustained long enough to make it a very valuable vasopressor drug. Neosynephrine .25% solution in 4 or 5 minimum doses is good for quick vasopressor effect but is of short duration.

Early in the year 1946, the author was furnished through the courtesy of the Bilhuber-Knoll Corporation, for experimental use, a supply of a new vasopressor drug, Oenethyl in 50 mg. ampules. The drug was first used as a prophylactic intramuscular injection 8 to 10 minutes before operation in a series of 86 cases receiving spinal anesthesia, pontocain-glucose method, for general surgical

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Senior Surgeon, Walker County Hospital, Jasper, Alabama.

operations below the diaphragm. A 50 mg. intramuscular dose was used in 33 cases and a 75 mg. dose in 53 cases and the results seemed better with a 75 mg. dose as a prophylactic. The duration of the operative procedures ranged from 10 minutes to 120 minutes, but only 3 of the operations lasted more than 60 minutes, and systolic blood pressure, pulse, and respiration rate were recorded at 10 minute intervals after the operative procedure started.

With one exception, Case 19, the following observations were made on the blood pressure, pulse rate, respiration, etc. The systolic pressure varied from the pressure recorded at the start of operation not more than 30 mm. of mercury during the operation in 80 per cent of the cases and most of these left the operating room with about the same pressure as that recorded before operation. The diastolic pressure did not vary more than 10 mm. of mercury in 90 per cent of the cases during operation. The pulse pressure remained at a safe level in all cases and varied between 35 and 40 mm. of mercury in the good majority of them.

The rate of the pulse was unchanged in 51 cases, increased from 10 to 20 beats per minute in 12 cases, 21 to 30 in 13 cases, 31 to 40 in 5 cases and the rate was decreased in 5 cases. The rate of respiration remained from 18 to 20 per minute in all cases except 4, the maximum respiration being 30, and in two of these cases there was nausea and vomiting. The most consistent side effect observed was nausea and vomiting, 19 of the 86 cases showing some degree of nausea, slight to moderate. Only 4 patients vomited and 2 had retching.

Case 19 was one of abdominal pregnancy in which there was massive blood loss during the operation, after which the pulse was imperceptible and the blood pressure dropped to 70 systolic and 40 diastolic. She was given Oenethyl intravenously in repeated 15 mg. doses and removed from the operating room in fair condition. She recovered after transfusions were given.

This drug has not been used by the author in shock from trauma nor in accident cases with severe hemorrhage. However, it has now been used during more than 750 major operations in which spinal anesthesia was given both as a prophylactic measure and as treatment for a fall in blood pressure. The author has not used the drug intrathecally along with the anesthesia mixture.

The anesthetist, Dr. William H. Ivey, is of the opinion that Oenethyl should be used in all cases where a sustained vasopressor effect is needed. However, he still prefers the use of intravenous ephedrine in those cases needing a rapid vasopressor boost.

Oenethyl has now been released for general use and the author would like to quote from an article in The Journal of Alabama State Medical Association, June, 1947, by Dr. John K. Taggart, Jr., Associate Surgeon, Walker County Hospital, Jasper, Alabama, in which he says, "During the past year we have been using a newly introduced vasopressor substance to control hypotension in spinal anesthesia. This drug, marketed under the trade name of Oenethyl, has been released for general use recently. It has been used both prophylactically and therapeutically. We have found it quite effective when administered as premedication in doses of 75 mgm. intramuscularly. It may be given either intravenously or intramuscularly to control a fall in blood pressure. When given intravenously it should be given in divided doses of 15 mgm. and the pressure checked repeatedly to avoid overdosage. Larger amounts, 75 to 100 mgm., are required, when given intramuscularly to produce the desired effect. In general, in severe hypotension the intravenous route is to be preferred. Side reactions, other than occasional nausea, are not seen with proper dosage. Following its administration there is a gradual and sustained rise in both systolic and diastolic pressure, an increase in the pulse pressure and mild stimulation of respiration.

"We have used this drug in over 500 major procedures and consider it superior to any of the drugs commonly used to control hypotension in spinal anesthesia."<sup>1</sup>

From this you can see that our staff on surgery, as well as our anesthetist, are of one accord in the opinion that Oenethyl is a valuable addition to the list of vasopressor drugs.

ALBERT C. JACKSON, M.D., F.A.C.S.  
Jasper, Alabama

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<sup>1</sup>Taggart, J. K., Jr.: Recent Advances in the Use of Spinal Anaesthesia, Alabama State M. A. (June) 1947.

Read before the Staff Conference of the Walker County Hospital, Sept. 5, 1947.

## BOOK REVIEWS

*The Editors of THE SOUTHERN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

**CINEPLASTY.** By HENRY H. KESSLER, M.D., Ph.D., Formerly Captain (MC) USNR; Formerly Chief of Amputation Center, United States Naval Hospital, Mare Island, California; Orthopedic and Amputation Consultant to the Office of Vocational Rehabilitation; Member of New Jersey Rehabilitation Commission; Diplomate of American Board of Orthopedic Surgery, 201 pages and 314 carefully selected illustrations. Price \$6.75. Springfield, Illinois—Charles C Thomas, Publisher, 1947.

Cineplasty is the method by which a muscular loop, surgically made, in the remainder of an amputated extremity, motivates the prosthesis. An active muscle within the arm stump is raised and sheathed in normal skin, leaving an opening underneath into which a through and through peg is inserted with its ends lying on the surface of the stump. When the muscle is voluntarily contracted the surface peg rather strongly moves away from the end of the arm. Flexor or extensor muscular loops, or both, each with its peg, may be constructed. When the prosthesis is fitted, the pegs are attached to it in different ways to provide the various movements desired. Special training and persistent practice in use of the apparatus is essential. Dr. Kessler tells why he believes this method best restores function to the amputee, namely, by a more efficient means of controlling the prosthesis, and by a better reproduction of the more important functions of the hand.

The author makes the scope of cineplasty, and the best way to utilize it, very clear to the reader. Both by text and by any number of good illustrations, he shows the surgeon the choice and details of operations. Also quite well illustrated and described is the wide selection of prostheses which can be made available to serve special purposes of the individual.

The principle of cineplasty may be effectively applied to congenital amputations. In some of these, when constructing a canal for the peg, Dr. Kessler finds it necessary to graft under the muscle, a tubed, pedicle skin flap from the abdomen.

Double arm amputations are discussed. It is shown what the amputee can do with and without prosthesis. To utilize all possible function, a muscle loop can be made even at the shoulder when one of the arms is off at that level.

One chapter describes plastic procedures to be used where parts of fingers or a part of the hand is missing. The value of the Krukenberg operation (split-end forearm stump, with tactile sensation) is given.

The final chapter, on "Rehabilitation," most important to the amputee, is interesting and enlightening.

Ross T. McIntire, Surgeon General, United States Navy, in his foreword, comments as follows:

"Doctor Kessler, from a wide experience both in civilian and military practice, has written a book designed to assist all who deal with the rehabilitation of the amputee. As he points out, their treatment is not a matter for the surgeon alone. The manufacturer of artificial limbs and appliances, the public, the patient's family, as well as the patient, are involved in the treatment. All of these have been considered by the author whose purpose has been to answer the many surgical and sociological questions which arise in the treatment of the amputee."

C. S.

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Dear Sir:

In the October 1947 issue of your valued Journal (Volume XIII, Number 10, page 717) appears an article by Dr. William Milton Adams, titled, "Free Composite Grafts of the Nipples in Mammoplasty," in which he states that the operation I devised, "the nipple is transplanted before the breast is reconstructed," and he speaks of a modification of this operation.

In a previous article in SURGERY (Volume 15, Number 1), January 1944, Dr. Adams stated, "Thorek, in 1921, reported: '*It is possible to disconnect completely the nipples and areole from the subadjacent beds and transplant them to a new position in the remodeled breast.*'" (Italics mine.) This is correct. I always disconnect the nipples first and then transplant them *on the remodeled breast* as the next step, although on occasion I have done the reverse to compare results.

Sincerely yours,

DR. MAX THOREK

Professor of Surgery

Cook County Graduate School of Medicine  
Chicago







# The Southern Surgeon

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WILL BE HELD AT

**THE HOLLYWOOD BEACH HOTEL**

**HOLLYWOOD, FLORIDA**

**April 5, 6, 7, 8, 1948**

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